

Nitrate and Health

Large amounts of nitrate in drinking water can cause serious illness in infants under six months of age. This brochure answers questions about nitrate contamination and health concerns.

What is nitrate?

Nitrate (NO_3) is a form of nitrogen combined with oxygen. It can be converted in the body to nitrite (NO_2). The major adult intake of nitrate is from food rather than water, but sometimes excessive amounts of nitrate get into drinking water.

How does nitrate get into drinking water?

Nitrate, one of the most widespread contaminants, can get into water if a well is improperly constructed or located where it is subject to contamination sources. Typical sources of nitrate include:

- wastes from livestock operations
- septic tank/drainfield effluent
- crop and lawn fertilizers
- municipal wastewater sludge application
- natural geologic nitrogen

Shallow water wells in sandy unconfined aquifers are more vulnerable to nitrate contamination than deeper wells protected by overlying clay strata.

What illnesses can nitrate cause?



Elevated nitrate in drinking water can cause a disease called methemoglobinemia, a blood disorder primarily affecting infants under six months of age. Also, because nitrate contamination can be related to human, animal, or industrial waste practices, excessive levels of nitrate in drinking water may indicate potential for the presence of other types of contaminants.

Elevated nitrate can also cause health problems in livestock.

What is Methemoglobinemia?

Methemoglobinemia reduces the ability of the red blood cells to carry oxygen. The acutely poisoned person will have a blue discoloration of the skin due to the reduction of oxygen in the blood. The condition can be fatal if not attended by a physician immediately.



Why are infants more susceptible than adults to nitrate-induced methemoglobinemia?

There are four reasons:

- (1) *Infants have a lower stomach acidity which allows growth of bacteria capable of converting nitrate to nitrite. Nitrite can change hemoglobin to methemoglobin, which cannot carry oxygen.*
- (2) *Young infants still have considerable amounts of fetal hemoglobin which is more easily converted to methemoglobin than the adult hemoglobin.*
- (3) *Infants are deficient in certain enzymes that are able to convert methemoglobin back to normal hemoglobin.*
- (4) *In relation to body weight, an infant consumes a much larger volume of water than an adult.*

What is “excessive” nitrate?

The U.S. Environmental Protection Agency has established a maximum contaminant level (MCL) for nitrate (as nitrogen) at 10 milligrams per liter (mg/L) and nitrite at 1 mg/L. The Michigan Department of Environmental Quality (MDEQ) has adopted these standards. Private water supply owners with excessive nitrate or nitrite should contact their local health department or family physician for assistance. Mortgage lenders may refuse to finance a mortgage if the home's water supply has nitrate above 10 mg/L.

Is there a treatment for the removal of nitrate from drinking water?

Nitrate can be removed from drinking water using reverse osmosis, ion exchange, and distillation. This equipment requires frequent, careful maintenance and sampling to achieve and confirm effective operation. Improperly installed, operated, or maintained equipment can result in nitrate passing through the treatment process. In some cases the nitrate will be concentrated above the incoming levels. Bacteriological problems can also develop in improperly installed and poorly maintained treatment systems. The MDEQ recommends that an alternate source of drinking water be developed, where possible, and bottled water be used for preparing infant formula. The local health department should be consulted for information on deepening wells to reduce nitrate levels. If a nitrate removal system is to be used, one with National Sanitation Foundation or equivalent certification should be selected. Boiling water will not remove nitrate and can concentrate it.



How often should samples be collected?

Unlike public water supplies, private household water systems are not required by law to sample for nitrate on a routine basis. If nitrate contamination is known to the area, or a sample indicates nitrate or nitrite levels approaching the drinking water standards, a minimum of annual sampling is recommended.

Can a water supply be properly evaluated on the basis of one laboratory analysis for nitrate?

No. A sample may be collected during dry weather from a poorly located and improperly constructed well near a barnyard, and found to contain little, if any, nitrate. The same well sampled following a rain could contain a much higher nitrate concentration. Therefore, a sanitary survey is necessary to fully evaluate the water supply and determine what may be done to eliminate or reduce the nitrate contamination. Such a survey includes review of the well depth, construction, location from potential sources of contamination, area geology, and ground water quality.

What kind of container should I use for collecting a sample for nitrate determination?

Any laboratory certified for nitrate analysis of drinking water can provide you with the proper sampling container. The partial chemical sample container furnished by the MDEQ is used by the state laboratory for nitrate analysis. Local health departments have a supply of these bottles or they can be ordered directly from the laboratory. Ask for Unit 32 when ordering and indicate test code R when submitting a sample to the MDEQ lab. Avoid using old or expired bottles.

When a water sample is analyzed for nitrate, how are the results reported?

The state laboratory reports results to the person submitting the sample. Nitrate results are reported to the MDEQ as milligrams of N per liter of water (mg/L, N). Other labs may report milligrams of nitrate (NO₃) per liter of water (mg/L, (NO₃)). Nitrite is reported as N. It is essential to know which units are used for reporting because they differ by a factor of 4.4. In other words, 10 mg/L, N can also be reported

as 44 mg/L, NO₃. Most laboratory reports will indicate which unit is used. Mg/L is the same as parts per million (ppm).



REFERENCES

Nitrates in Groundwater, Larry W. Canter, Lewis Publishers, 1997, CRC Press, Inc., Library of Congress Catalogue Card Number: 96-5855.


Drinking Water and Health, Safe Drinking Water Committee, Advisory Center on Toxicology, Assembly of Life Sciences, National Research Council, National Academy of Sciences, Washington, D.C., 1977, Library of Congress Catalogue Card Number: 77-089284.

For more information please contact your local health department, your physician or:

Michigan Department of Environmental Quality
Water Division
Groundwater Section
PO Box 30630
Lansing, MI 48909-8130
Phone: 517-241-1377
Fax: 517-241-1328

Environmental Assistance Center 1-800-662-9278 Internet address: www.michigan.gov/deq

The Michigan Department of Environmental Quality (MDEQ) will not discriminate against any individual or group on the basis of race, sex, religion, age, national origin, color, marital status, disability or political beliefs. Questions or concerns should be directed to the MDEQ Office of Personnel Services, P.O. Box 30473, Lansing, MI 48909.

Printed by Authority of 1976 PA 399
Total number of copies printed: 10000. Total cost: \$435.55 Cost per copy: \$.023
 Michigan Department of Environmental Quality

State of Michigan
Jennifer M. Granholm, Governor

Department of Environmental Quality
Steven E. Chester, Director

A PUBLIC HEALTH PROBLEM

NITRATE IN DRINKING WATER

**Information for private
water well owners**



**Michigan Department of
Environmental Quality**

Water Division